

What is claimed is:

## **CLAIMS**

1. A method of inducing residual compressive stresses in the surface of a part comprising the steps of:  
performing a first operation to induce deep compressive surface stresses along a portion of the surface of the part; and  
performing a second operation to induce more shallow compressive surface stresses along a portion of the surface of the part.
2. The method of Claim 1 wherein the first operation is performed with an apparatus for inducing residual compressive stresses comprising a burnishing member having a first diameter and the second operation is performed with a burnishing member having a second diameter.
3. The method of Claim 1 wherein the second operation is performed in more than one pass.
4. The method of Claim 1 wherein the operations are performed in a single pass of the apparatus.
5. The method of Claim 1 whereby the operations are performed using single point burnishing members.

6. The method of Claim 1 wherein the temperature of the surface of the part during the first operation is of a first temperature and the temperature of the surface of the part during the second operation is of a second different temperature.
7. The method of Claim 1 wherein the first and the second operations are performed using burnishing members and the modulus of elasticity of the burnishing member performing the first operation is different than the modulus of elasticity performing the second operation.
8. The method of Claim 1 wherein the first and second operations are performed such that the amount of surface cold working is less than about 5.0 percent.
9. The method of Claim 1 wherein the first and second operations are performed such that the amount of surface cold working is less than about 2.0 percent.

10. The method of Claim 1 wherein the desired layer of compressive residual stress to be induced within the surface of the part is determined using x-ray diffraction techniques.
11. A method of inducing residual compressive stresses in the surface of a part comprising the steps of:  
selecting at least one region along the surface of the part for inducing a first layer of compressive stresses within the surface of the part;  
performing a first burnishing operation using a first burnishing member to induce a first layer of compressive surface stresses along a selected region of the part ; and  
performing a second burnishing operation using a second burnishing member to induce a second layer of compressive surfaces stresses along a selected region of the part;  
wherein said first burnishing member has a first diameter and said second burnishing member having a second different diameter.
12. The method of Claim 11 wherein the modulus of elasticity of the burnishing member performing the first burnishing operation is different than the modulus of elasticity performing the second burnishing operation.

13. The method of Claim 11 wherein the temperature of the surface of the part during the first burnishing operation is of a first temperature and the temperature of the surface of the part during the second burnishing operation is of a second different temperature.
14. A method of inducing residual compressive stresses in the surface of a part comprising the steps of:  
selecting at least one region along the surface of the part for inducing a first layer of compressive stresses within the surface of the part;  
performing a first burnishing operation using a first burnishing member to induce a first layer of compressive surface stresses along a selected region of the part ; and  
performing a second burnishing operation using a second burnishing member to induce a second layer of compressive surfaces stresses along a selected region of the part;  
wherein the first burnishing operation is performed when the temperature of the surface is at a first temperature and the second burnishing operation is performed when the temperature of the surface is at a temperature different than the first temperature.

15. A method of inducing residual compressive stresses in the surface of a part comprising the steps of:
- selecting at least one region along the surface of the part for inducing a first layer of compressive stresses within the surface of the part;
- performing a first burnishing operation using a first burnishing member to induce a first layer of compressive surface stresses along a selected region of the part ; and
- performing a second burnishing operation using a second burnishing member to induce a second layer of compressive surfaces stresses along a selected region of the part;
- wherein said first burnishing member has a modulus of elasticity that is different than the modulus of elasticity of said second burnishing member.
16. An apparatus for inducing a layer of compressive residual stress within the surface of a part comprising a first burnishing member and a second burnishing member; wherein said first burnishing member has a first diameter and said second burnishing member having a second different diameter.

17. The method of Claim 16 wherein the apparatus comprises a plurality of burnishing members of consecutively smaller diameters.
18. The apparatus of Claim 16 wherein said first burnishing member is fixed in a first positioning device and said second burnishing member is fixed in a second positioning device.
19. The apparatus of Claim 16 wherein said first burnishing member and said second burnishing member are fixed in a single positioning device.
20. The apparatus of Claim 16 wherein the modulus of elasticity of the said first burnishing member is different than the modulus of elasticity of said second burnishing member.